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# Worldwide Report

TELECOMMUNICATIONS POLICY,  
RESEARCH AND DEVELOPMENT

No. 148

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ASIAN, PACIFIC NEWS AGENCIES MEET IN DELHI

New Delhi PATRIOT in English 25 Dec 80 p 5

[Text]

REPRESENTATIVES of news agencies from countries of Asia and the Pacific have called for reduction of telecommunication tariffs between countries in the region, reports UNI.

They have also urged that the INTERSAT agreement be altered to enable domestic satellites launched by countries in the region to be used for regional television news and programme exchange, a UNESCO release said.

At their meeting in New Delhi last week, the representatives unanimously recommended the establishment of a network for news exchange among countries of Asia and the Pacific.

The representatives agreed that the existing Organisation of Asian News Agencies (OANA) should be the nucleus body to provide the organisational framework for the new network, the release said.

The network is to enable each country in the region to send and receive news from its neighbours directly so as "to establish better understanding and close socio-economic and cultural contacts."

The meeting recommended that a special technical working

group be set up with the help of UNESCO and the International Telecommunications Union to assess the technical capabilities which already exist in the region and identify those areas where new technical arrangements should be made or existing facilities strengthened.

OANA will meet in Kuala Lumpur next year to make the necessary modifications in its statutes and organisation to be able to play the expanded role envisaged for it.

Organised by UNESCO in co-operation with the Indian Ministry of Information and Broadcasting and the Indian Institute of Mass Communication, the New Delhi meeting recommended that a Regional Resource Centre be set up for documenting television, radio and film programmes available for exchange. The centre should also have facility for handling video cassettes and film programmes.

Another recommendation related to building and strengthening national capabilities in the area of teaching. The role of cinema in communication training was stressed, the release said.

CSO: 5500

INTER-ASIAN AFFAIRS

BRIEFS

INDIA, BANGLADESH TELEX--New Delhi, 14 Dec (PTI)-- International telex service to Bangladesh has been made available with immediate effect. The service will be available continuous on all days, according to a notification issued by the director-general, Overseas Communications Service. [Text] [Bombay THE TIMES OF INDIA in English 15 Dec 80 p 5]

CSO: 5500

MINISTER TELLS TELECOMMUNICATIONS PLANS

Dacca THE BANGLADESH OBSERVER in English 8 Dec 80 p 12

[Text] Barisal, Dec 7 --Telegraph and Telephone Minister Mr Mayeedul Islam today said that the microwave telecommunication station now under construction here will be commissioned by March next, reports ENA.

Inaugurating the fourth Telecommunication Training Subcentre here this afternoon the Minister said that the present 12 STD channel between Barisal and Dacca will be raised to 24 channel while the existing four trunk channels will be raised to six channels shortly. With the commissioning of the microwave station, telecommunication between Barisal and Dacca Chittagong and Khulna will greatly improve Mr. Mayeedul Islam said.

The Minister said that measures are also being taken to improve and further expand wireless system of teleling with the coastal belts of the country including Sandwip and Patuakhali. [as published]

Mr Mayeedul Islam said that the fifth training centre for T and T staff will be opened at Chittagong this month and the sixth will be opened at Bogra shortly. The centres will provide training in handling most modern telecommunication equipment. He said a scheme has also been taken up for construction of hostel buildings and class rooms for the trainees.

The function was also addressed among others, by Mr Abdur Rahman Biswas, a former Minister District Development Coordinator Mr Mosharraf Hossain Shah Jahan MP and Chairman of the T and T Board Mr M A Taher.

CSO: 5500

## BRIEFS

SATELLITE LIFE EXPECTANCY--Bangalore, December 23 (PTI): India's first earth observation Satellite Bhaskara, is expected to "die" in space in about three months because of depleted fuel resources, after functioning much longer than anticipated. The satellite, launched in June 1979 from Moscow, was projected to be active for one year but was still sending on an average ten pictures per day, Prof. U. R. Rao, director of the ISRO satellite centre, told PTI today. About 4,000 pictures had so far been beamed to earth stations, he said. He said Bhaskara's TV cameras photographed the entire country once in 20 days of its orbit round the earth. Prof. Rao said the pictures, now being processed by various government agencies, would be useful in studying deserts, snow melting, coastal erosion and growth and decay of biomass. Meanwhile a model of Bhaskara-2 today successfully completed space simulation tests at the ISRO centre. Prof. Rao told PTI that Bhaskara-2 would be ready by May next, and the satellite would be launched from Moscow a few months later. A team of Russian scientists was in the city about two months ago to work out the details, he added. [Text] [Bombay THE TIMES OF INDIA in English 24 Dec 80 p 9]

INTERNATIONAL DIRECT DIAL--Direct international telex service with subscriber dialling facility will be available with Poland, Czechoslovakia and Taiwan with immediate effect, according to an official release. With this, fully automatic subscriber dialled international telex service is now available to the 46 countries. [Text] [New Delhi PATRIOT in English 27 Dec 80 p 5]

PUNJAB-KASHMIR DIRECT DIAL--Jammu, Dec 26 (UNI)--The Post and Telegraph department is commissioning STD facility from Jammu and Kashmir to Punjab, Haryana and Himachal Pradesh from 28 December. Now Jammu, Srinagar and Udhampur will have direct dialling connections with Ambala, Amritsar, Bhatinda, Chandigarh, Ludhiana, Patiala, Simla and Jullundur. [Text] [New PATRIOT in English 27 Dec 80 p 2]

CSO: 5500



## BRIEFS

DERA ISMAIL KHAN INAUGURATION--Dera Ismail Khan station of Radio Pakistan was inaugurated by the NWFP governor, Lt-Gen Fazale Haq today. It is the second radio station in the NWFP, and the 13th in the country, and has been completed at a cost of over 9.5 million rupees. Speaking on the occasion the provincial governor described the new 10-kw mediumwave radio station as a milestone, an important step forward in linking Dera Ismail Khan with the rest of the country, and bringing the people of the area closer to their brothers in other parts of the country. In his address of welcome, the chairman of the Pakistan Broadcasting Corporation, Maj-Gen (?Mujibur Rahman) said the radio station will have a listening range of 20,000 square km enabling a large number of people to listen to Radio Pakistan. He said it would broadcast programs for over six hours daily, and (?carrying) two and a half hours originating from Dera Ismail Khan station in Urdu, Tarakki (as heard) and Pashto. [Excerpt; [LD151450 Karachi Overseas Service in English 1005 GMT 15 Jan 81]

CSO: 5500

PEOPLE'S REPUBLIC OF CHINA

BRIEFS

OPTICAL FIBERS FOR COMMUNICATION--Shanghai, 15 Jan (XINHUA)--China will produce two of the key components used in optical fiber communication. The key components--graded multi-mode phosphosilicate optical fiber and four- and six-fiber optical cables--were approved in product assessment last December and will become available commercially. They were developed by the Shanghai Institute of Silicate Research under the Chinese Academy of Sciences, the Shanghai Cables Institute and the Shanghai Xinhua Glass Factory. The assessment proved that the physical and mechanical characteristics of the components are close to world level. China began to study optical fiber communication in 1974. [Text] [OW150752 Beijing XINHUA in English 0744 GMT 15 Jan 81]

CSO: 5500

## NEW TELEPHONE SERVICE INITIATED, DEVELOPMENTS NOTED

Bangkok BANGKOK POST In English 31 Dec 80, THE ECONOMY REVIEW Supplement pp 63, 64

[Text]

A TELEPHONE call from Bangkok to Chanthaburi Province recently opened up a new era for telecommunications in Thailand.

The call made on Monday morning, December 15, by Prime Minister Prem Tinsulanonda to Chanthaburi Governor Bunnag Saisawang, inaugurated the Telephone Organisation of Thailand's nationwide direct dialling system, an 18,000 million baht project which now links up the whole country with a chain of automatic exchanges.

In a speech at the opening ceremony, Gen Prem said the new service would promote the economic and social development of the nation.

There are three branches of telecommunications in Thailand: TUT, the Communication Authority of Thailand and Aeronautical Radio of Thailand Ltd. This last, however, has little to do with the lives and activities of the great majority of people.

It is TUT which attracts the attention — and criticism — of the public. This organisation is among several state enterprises which have recently had to undergo the severest public chiding.

But the criticism has not fallen on deaf ears — it has to a certain extent galvanised TUT into action. Between 1964 and 1980 TUT has implemented eight projects, through which capacity has been multiplied almost 10 times to 432,000 lines — at the end of the first quarter of 1980, of which 314,000 were in Bangkok and the remaining 108,000 in the provinces. Connected lines on March 31 (mid-fiscal year 1980) totalled 351,000. Of these, 258,947 were in Bangkok and 92,052 in the provinces.

These lines served by 42 exchanges in the Bangkok Metropolis and another 134 exchanges in the provinces. Public telephones numbered, on March 31, 5,874 of which 5,214 are in the capital area and 660 in the provinces.

The automatic long-distance dialling service was begun two years ago, when the equipment on the Bangkok to Chuang Mai line was automated. Results in this initial stage were very satisfactory. The second locality to benefit from the project was Pattaya. From February 24, 1979, residents in the resort have been able to dial Bangkok directly.

Technically, automatic long-distance is called Subscriber Trunk Dialling (STD). The STD concept divides the country into 21 zones, each with an area code number. Bangkok Metropolis is regarded as the first zone and is given a two-digit area code number — 02. The remaining 20 zones are each given a three-digit area code number. There are seven zones in the Central Region, with the area code numbers 032, 034, 035, 036, 037, 038 and 039.

The Northeast and the North have four zones each, while the South has five. The area code numbers in the Northeast are 042, 043, 044 and 045; those in the North 053, 054, 055 and 056, and those in the South 073, 074, 075, 076 and 077.

Currently, TUT is working on a project titled "The Economic Development Programme of the Telephone Organisation of Thailand 1977-1984," or EPT 1977-1984. The Government approved this seven-year programme on May 23, 1979, earmarking a total investment of 10,828.2 million baht.

## VOLUME INDICES OF TELEPHONE SERVICES IN 1980

	In Bangkok	In Provinces	All Country
Number of exchanges	42	152	194
Number of lines	314,685	109,700	421,384
Number of lines per 100 people	4.87	0.28	0.80
Number of lines/demand	64.04%	41.62%	56.28%
Shortages of lines	174,416	159,700	324,116
Number of waiting months	56	100	80

Source: TOT

At the end of the 1977-1984 plan, TOT's capacity will be boosted to a total of 743,500 lines, almost doubling the present figure. Of this total, 538,000 lines will serve the Bangkok Metropolis and another 205,500 lines the provinces. The number of lines in the metropolitan area will be more than twice the figure in 1980.

Complaints are often voiced privately or by the media about the slowness of telephone supply. Lucky applicants have to wait two or three years before having telephones installed — the unlucky ones have to wait much longer.

TOT's statistics show that at present there are 0.86 phones for every 100 people in Thailand. The ratio is lower than that in Malaysia and Singapore. It also falls below the internationally recommended standard for developing countries of a minimum of one telephone for every 100 people.

However, the ratio for the capital area is considerably higher than the average for the whole country. There are 4.87 phones for every 100 people in Bangkok. In the provinces the ratio is 0.28 per 100.

Looking at this problem from another angle, it is estimated that 56.28% of the demand for telephones is met nationwide. The figure for the Bangkok Metropolis is 64.04%, while for the provinces it is 41.62%.

Questioned about how the telephone demand figures were derived, a source at TOT explained, "About two years ago, we invited the public — through the media — to apply for phones, with the stipulation that they buy bonds issued by TOT. A very large number responded to our invitation.

"It appears that these were the people who would be willing to purchase our phone services at the price (i.e. the value of the bonds plus certain fees) offered to them. These people therefore can be regarded as the ones who were in the market for phones under the existing economic circumstances."

TOT estimates that at present subscribers have to wait a maximum of 80 months before it can answer their demand. The maximum waiting period in the capital area is 45 months, while in the provinces it is 100 months.

Another index of the progress of the telephone services is their distribution, which is measured by the number of districts served by telephones. At present, TOT's system links 138 out of a total of 660 districts. In large districts those with a population of more than 100,000 — 73 of a total of 138 have telephones. In districts with a population of between 50,000 and 100,000, 42 of a total of 109 are served, and in districts with a population of 10,000 and 50,000 only 19 of a total of 285 have telephones installed. None of the 17 smallest districts, with less than 10,000 people, have telephones.

Although TOT has of late quickened the pace of its development programme, it still has a rather long way to go. But in its hurry TOT must not overlook the quality of its services, because this is an area in which it has been found very much wanting.

Aeronautical Radio of Thailand Ltd and the Communication Authority of Thailand have received rather less criticism from the public than TOT.

Formed by the Government relatively recently to fulfil its obligations to the

International Air Transport Association. Aeronautical Radio has as its main task the control of all traffic over the country's airspace. Given this type of assignment, its work benefits of has rapid expansion on people in this country only when they travel by air.

This is not, however, to be taken the case of this state enterprise, or to say that it is inefficient. In fact, its efficiency is rated very highly. The fact that there have been very few aviation mishaps in Thailand is a testimony to the efficiency of this concern.

The Communication Authority of Thailand was formed in February 1977 to take over all the telecommunications functions of the Post and Telegraph Department, which switched to the role of a national planner and developer of the country's telecommunications services. The tasks of the Communication Authority of Thailand include postal ser-

vices, telegraph, overseas cable, voice and wireless telecommunications.

The authority will very soon sign a contract with the U.S. to rent channels provided by the Intersat satellite at 10 million baht a year. This will be in addition to the country's present satellite link. The new channels to be provided or leased are for domestic use. Transmitting television programmes and sending telex and telegraph messages to 14 receiving stations throughout the Kingdom.

In mid-1980 representatives of the Communication Authority of Thailand attended a meeting which agreed that the inter-ASEAN cable system would be extended in Thailand. Underwater cable will be laid from Pathehai to Bangkok where a control station will be built. Another line will be laid to link Bangkok with Singapore. The construction will cost between 600 million and 1,000 million baht, and will take roughly two years to complete.

## THAILAND

### TELEPHONE SYSTEM PROBLEMS, DEVELOPMENTS DESCRIBED

Bangkok SIAN RAT in Thai 6 Dec 80 p 5

[Article by Chamret Thanaprakop: "Hello...Bangkok Telephone Exchange? What Are You Doing?"]

[Text] Concerning telephone communications between Bangkok and the provinces in the various regions, since 1 August it has been possible to use automatic, direct dialing just as when calling within one's local area.

It is not necessary to place the call through the operator as before.

At the same time, the provinces immediately surrounding Bangkok and some of the more remote provinces can call to Bangkok using the automated system.

And it has been said that if everything goes according to plan, by the end of this year, all the provinces in the country will be able to call each other directly.

This is an advance by and accomplishment of the Telephone Organization of Thailand that should be sincerely applauded.

But I feel that I must wait a moment longer before applauding because there are still many problems and complaints that no one has cleared up. Thus, the question of just what the Telephone Organization of Thailand is doing at present has arisen.

Concerning the slowness of the service, the impoliteness of the employees and all the other bad things that happened in the recent past, even though these things are difficult to forget, here I feel that those things must be set aside for now. Because, that long period that is now in the past can be called a period of inertia of the Telephone Organization and backwardness was still deeply embedded in the minds of many people. It would not do any good to talk about these things and would only be very distressing.

but at present, the Telephone Organization of Thailand, especially the Bangkok exchange, is a sector with a fully automated system. Therefore, everything must be developed in accord with the automated system.

But things have not happened like this.

The first matter that must be discussed concerns the employees. That is, after the automated system went into use, instead of the employees becoming more energetic, they have become even more lethargic than before. Every day, large numbers of people go to use the long-distance telephone service at the Ploenchit exchange. But there are only two telephone booths at this exchange. Each time a person goes to make a call, it takes at least 30 minutes before he can place his call.

I once asked an employee there about this and he said that the slowness was not the result of any interference but came about because the operators were not willing to place the calls. Also, calls from the Ploenchit exchange must first be patched through the Krungkasem exchange and the officials at the Krungkasem exchange are never willing to work very much, even when there is little work, because this is not in a very convenient communications line.

This leads to questions about how the Telephone Organization of Thailand administers the work.

In front of the Ploenchit exchange, which is a busy business district, there is a sign that says that this is the Telephone Organization of Thailand. However, the long-distance telephone section is a minor branch of another exchange. Whenever some obstacle arises, people are uncertain about whom to contact.

Is this something "clever" or is the Bangkok communications's organization in a state of confusion?

At present, there is lively talk to the effect that since the automated system was installed, many employees of the Telephone Organization have been transferred as appropriate. While they have not been fired, they do not know if the future holds anything good for them. Most of the employees who talk like this are now working at various exchanges, some in Section 11 and some in Section 12, which are overstaffed. Isn't this a waste?

Someone should complain about this and try to find a better way of doing things than this.

Concerning long-distance telephone rates, previously, in calling from Bangkok to certain provinces such as Nrat, the rate for the first 3 minutes was 15 baht. Now, however, the rate is 24 baht. This shows



that they are taking an advantage about which the telephone users can do nothing. Even though the Telephone Organisation claims that this rate increase was necessary, in a period such as today when most people are encountering economic difficulties, this does not seem right.

It is true that they now calculate the time by the minute but if a person talks longer than a minute, he is charged for 2 minutes. Thus, if the rate for 1 minute is 8 baht, the caller must pay 16 baht. Previously, if the caller talked longer than 1 minute he was charged for the full 3 minutes, which was only 15 baht. This was much cheaper.

Concerning this example, it is not just a matter of the money. I just feel that this is too much.

And in fact, the people who use the long-distance service must have urgent business or it must be urgent that they call. And just 1 or 2 minutes is probably not enough time. The Telephone Organisation should consider this.

What is strange is that it has been stated that, concerning the telephones that are capable of automatic long-distance dialing, if a person wants to have the exchange operator place the call for him, he must pay an additional charge. Using common sense, it is not too difficult to figure out why this regulation was implemented.

Besides this, there has been another notice to the effect that if the services at the exchanges are used directly, this added charge will be waived. It is probably for this reason that most people still prefer to go call from the exchanges. But people become frustrated and irritated, this wastes time and the chance to do other things is lost. And yet it seems that people think that calling from an exchange is more convenient and faster.

But this is not correct.

The truth is that most people use the exchanges because they do not have telephones. Even people living in Bangkok, who live right nearby, have encountered this problem. Why does it take so much time to obtain a telephone? Sometimes it takes a year or even several years.

At present, Thailand has developed to its present level. Why, therefore, is the most important form of communications so backward? If things are so bad in Bangkok, what must they be like in the remote areas. This matter should be reviewed and discussed.

Looking at things more deeply, in reality, the telephone is a communications tool that has given rise to much wonder and it is the only tool that has charm. I have been infatuated with this tool.



for a long time. I have had contact with telephones since I was a child. It has been a magical friend during periods of loneliness.

The sweet and cajoling sounds that come through the line make it difficult to forget.

The complaints expressed here are those of a person who has been an admirer for a long time.

I would like [the Telephone Organization] to make progress rather than see it move backwards. I have no other intentions than this.

1194)

Cao: 5500

## THAILAND

### BRIEFS

TELEPHONE LINES TO EAST--The Telephone Organization of Thailand will improve the long-distance telephone cables in the east from Rayong to Chanthaburi in order to prepare for the implementation of automatic long-distance telephone service. This will be carried on between now and the 31st of this month. The Telephone Organization of Thailand has stated that it will start improving the long-distance telephone cables between the Rayong and Chanthaburi exchanges now in order to prepare for the implementation of automatic long-distance service. This will sometimes interfere with long-distance telephone service between Bangkok, Chanthaburi and Trat for a short period while the improvements are underway. Things will be finished by the 31st of this month. [Text] [Bangkok Siam rat in Thai 10 Dec 80 p 3] 11943

CMU: 5500

## BRIEFS

MOROCCAN-FRENCH TELEVISION AGREEMENT SIGNED--An agreement to set up a second television channel of the Moroccan television service was signed at the Ministry of Information between the Moroccan Government represented by Minister of Information Abdelwahid Belakriz and the French company Sofirad [Radio Broadcasting Financing Company] represented by [name indistinct], chairman and managing director of the company. The first will cover construction of basic engineering and building installations through which the transmitting stations will cover the governorate of Rabat and Casablanca and the regions of (Mouknaas), Taza and Marrakech. The second stage will be concerned with covering eastern Morocco and (?northern regions). [Excerpt] [Rabat Domestic Service in Arabic 2000 GMT 22 Jan 81 LD]

CSO: 3500

## BRIEFS

**BROADCASTING DEVELOPMENT**--Minister for Information and Broadcasting Peter Oloo-Aringo has told department heads in Lamu District that his ministry's aim is to mobilize and motivate the citizens in their development activities. Noting that media communication makes all Kenyans feel that they belong to the same republic, "he pointed out that there are plans to enable all Kenyans to receive VOK [Voice of Kenya] broadcasts to counteract unwholesome propaganda that is broadcast from outside. To this effect, he said, work on the completion of transmitter installations at Voi and Garissa is expected to be completed within this development plan period. He said there are also plans to improve radio reception at the coast, to enhance the tourist industry." [LD190452 Nairobi Domestic Service in English 0600 GMT 17 Jan 81 EA]

**RADIO SERVICE DECENTRALIZATION**--The government is intending to decentralize radio services in the country by establishing regional radio stations as a measure aimed at reducing radio propaganda influence beamed to Kenya from neighboring countries. This announcement was made today by the minister for information and broadcasting, Mr Peter Oloo Aringo, when he made an inspection tour of broadcasting and television facilities at Mombasa. Flanked by his two assistant ministers, Mr Okuku and Mr Mhogori, Mr Aringo noted that the existing radio broadcasting facilities at Sauti [Broadcasting] House in Mombasa were underutilized and said that the government might open a regional radio station, using the facilities, as well as the Nyali transmitter station. He explained that the regional stations would be controlled from the ministry's headquarters in Nairobi. The minister said that radio stations were amalgamated during the independence [presumably struggle] owing to the great threat of regionalism, but now that [presumably under] President Daniel Arap Moi the people of Kenya were united under one government, the question of regionalism no longer existed. He also announced the formation of a program development committee to peruse and recommend on programs. [Text] [LD200058 Nairobi Domestic Service in English 1600 GMT 19 Jan 81]

**TRANSMITTER NETWORK EXPANDED**--The minister for information and broadcasting, Mr Peter Oloo Aringo, has said that the government is to spend over two hundred million shillings in erecting several radio transmitting stations all over the country, to improve reception throughout the republic. Speaking at Wundanyi, in Taita-Taveta district, Mr Aringo said the VOK transmitting station, currently under construction, will be ready by the end of October this year. He was accompanied by his two assistant ministers, Mr Steere Mhogori and Mr Alphonse Okuku. [Excerpt] [LD211104 Nairobi Domestic Service in English 0400 GMT 20 Jan 81 EA]

FRANCE

BRIEFS

NEW RADIO NETWORK--The Quai d'Orsay is going to set up an autonomous radio network so that its embassies will no longer have to depend on local communications systems, particularly in case of an internal or external crisis. Two allocations of 4.6 million francs each will be released for this radio network. [Text] [Paris LE POINT in French 19 Jan 81 p 32]

CSDB 3500

## DESIGN OF MICROSTRIP INTEGRATED OPTIC, MICROWAVE DEVICES

Milan ALTA FREQUENZA in English Jul-Aug 80 pp 298-303

(Article by Marco De Sario, Istituto Elettrotecnico, Università di Bari: "Design of Microstrip Integrated Optic and Microwave Devices")

## [Text]

**Abstract.** This paper illustrates the computer aided determination of the characteristic parameters of the even mode and N-1 odd normal modes propagating on a system with N coupled, commensurate, opened microstrip lines on anisotropic substrates by the image technique. Particular emphasis is given to the evaluation of the ohmic and dielectric loss coefficients whose calculated values closely agree with the published ones relative to the isotropic substrates.

As applications, the design criteria of an electrooptical traveling wave modulator and of several passive microwave integrated circuits (a three quarter line and a hairpin filter) are outlined. With respect to the fabricated devices, the agreement of the design results with the experimental data is very satisfactory.

## INTRODUCTION

Anisotropic substrates of lithium niobate or lithium tantalate are the most promising to the realization of laser beam modulators exploiting electrooptical effects induced by the application of a driving radio-frequency electric field. The waveguiding structure, therefore, must be investigated, to obtain an optimum modulator performance, both at optical frequencies [1] and at microwave where the traveling wave modulator configuration is arranged like two coupled microstrips as portrayed in Fig. 1. By the other hand the coupled microstrip lines on isotropic substrates have been organized

in various ways to constitute interdigital, meander and, more in general, hybrid patterns as matching networks in wideband microwave amplifiers, directional couplers and filters. Several authors have studied by different methods the M.I.C.'s because of their videoptical use in these years. To mention a very few, Mac [2], assumed a quasi-TEM mode propagation and determined the losses and the dispersion effects in microstrip directional couplers. Porret and Adams [3], used the matrix technique to extend the static method to the propagation constant evaluation of supported modes in open and covered microstrips.

Spielman [4] treated the microstrip problems by finding equivalent charge density distribution whereas Jansen [5] presented a C.P.U. computer time optimized and rigorous hybrid mode solution for arbitrary thickness microstrip geometries. At last Syahhal and Mariani [6] employed Legendre polynomials in the investigation of coplanar and microstrip-type structures by spectral domain technique. All combine the perturbation method to estimate the ohmic and dielectric losses for a multilayer isotropic waveguide. The radiation losses there were not been considered because they become predominant at higher frequencies with substrates having a low dielectric constant [7]. Alexander and Brown [8] determined the characteristic impedances and phase velocities for covered microstrips on anisotropic substrate by the moment method. This paper investigates the microwave propagation characteristics of a set of N coupled microstrips on anisotropic substrates by defining the Green function [9] for the Silverman's partial multiple images. The even mode and the N-1 odd modes characteristic impedances, the corresponding effective dielectric constants and the phase velocities are determined via a fast computer program.

for different sizes of the waveguide. Then, the perturbative approach is applied to evaluate the ohmic and dielectric loss coefficients. The numerical results for isotropic substrates closely agree with those already published. The electrostatic values, corrected by means of the Gotsinger dispersion formula, can be advantageously utilized to determine the modulation efficiency in a traveling wave type electrooptical modulator where a fraction of the light beam guided in the waveguide diffused core may escape in the substrate dependently by the microwave modulating electric field. Besides, a three meander line and a three-section hybrid-pattern filter having a bandwidth of 800 MHz centered at  $f_0 = 10$  GHz have been designed. The last devices have also been realized on alumina board already golded on both faces with a technology similar to that one of the printed circuits via an F.M.I. apparatus. The agreement between the calculated and measured insertion loss values was very encouraging.

## 2. 2-N PORT ADMITTANCE MATRIX OF N COUPLED MICROSTRIPS ON ANISOTROPIC SUBSTRATE

In the quasi-TEM approach the 2-N port admittance matrix of N parallel commensurate microstrip lines is solely related to the electrostatic Maxwellian capacitance for unit length matrices  $C$  and  $C_0$  with and without dielectric respectively. These matrices can be derived by determining the charge density distributions on the metal layers by a numerical integration of the first order Fredholm integral equation whose kernel is the structure  $G(P, Q)$  Green function. By following the classical method of the multiple images proposed by Silverman in 1966 and by an appropriate coordinate transformation it is found [9] for the electrostatic equivalent-two ribbon very thin conductor:

$$(1) \quad G(y, y_0) = \frac{1}{2\epsilon_0(1+\epsilon_{xy})} \sum_{n=1}^{\infty} k^{n-1} \ln \frac{4n^2 + [(y-y_0)/(nD)]^2}{4(n-1)^2 + [(y-y_0)/(nD)]^2}$$

where  $k = (1 - \epsilon_{xy}) / (1 + \epsilon_{xy})$  is the image-coefficient,  $\epsilon = \epsilon_{xy} / \epsilon_0$ ,  $D$  the thickness of the anisotropic substrate whose principal directions are parallel to the coordinate axes. For a finite thickness  $t$  of the metal layers the Green function is:

$$(2) \quad G(x, y; D+d, y_0) = \frac{-k}{4\epsilon_0} \ln \frac{[x-(t-d)]^2 + (y-y_0)^2}{[x-(D+d)]^2 + (y-y_0)^2}$$

where the unit line charge is at the source point  $Q(D+d, y_0)$ . The calculation accuracy, of course, depends on the truncation of the infinite series (1) or (2) and on the number of the substrates. This is in contrast with the C.P.U. computer time consuming and the storage, respectively. However, we have found that, for a truncated number  $N_{max} = 30$  and a substrate width of the order of  $bw/D = 0.02$  for small strips and  $bw/D = 0.1$  for large ones, the numerical result sensitivity is very small. As an example,

After the numerical evaluation of the symmetric real matrix elements  $\epsilon_{ij}$  and  $\gamma_{ij}$  as the average density per unit length lying in the  $i$ -th conductor ( $i=1, N$ ) when the  $j$ -th strip is at the potential of 1 and the other strips are grounded, the  $N \times N$  real and different diagonal matrices  $\epsilon$  and  $\gamma$  are determined as the eigenvalues of the hermitian matrix product  $\epsilon^* \epsilon$  whose orthogonal eigenvectors define the fundamental matrix  $M$ . The transverse wavevectors of the propagating normal modes

and, finally, the 2N x 2N adjacency matrix of the  
combined micrometry lines. I believe this is written  
as  $\hat{A}$ .

$$V = \begin{vmatrix} A_1 & A_2 \\ A_1 & A_2 \end{vmatrix} = \begin{vmatrix} C.M. \frac{1}{\sin(\theta_1 - \theta_2)} & M' \\ C.M. \frac{1}{\sin(\theta_1 - \theta_2)} & M \end{vmatrix} \begin{vmatrix} A_1 \\ A_2 \end{vmatrix}$$

In the expression (1)  $v$  is the light velocity in the medium,  $\alpha$ , the imaginary attenuation media factor and the symbol  $\delta$  indicates a diagonal unit matrix,  $\delta_{ij}$  are Kronecker deltas. If the conductive lines different widths  $w$ , for each line are defined by characteristic admittance, while for uniform lines these are equal and, as an example, if  $w =$

$$\frac{d}{dt} \left( \frac{\partial L}{\partial \dot{x}} \right) = \frac{\partial L}{\partial x}$$

$$r_{12} = \frac{1}{2} \left( \frac{1}{r_{11}} + \frac{1}{r_{22}} \right) + \frac{1}{2} \left( \frac{1}{r_{11}} - \frac{1}{r_{22}} \right) \cos 2\theta = \frac{1}{2} \left( \frac{1}{r_{11}} + \frac{1}{r_{22}} \right) + \frac{1}{2} \left( \frac{1}{r_{11}} - \frac{1}{r_{22}} \right) \cos 2\theta$$

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To calculate the enthalpy coefficients  $\alpha_i$ , we use the relationship used all because the model is a linear one, owing to the fact that losses are due to one- and two-way mixing:

191. *Chrysomelidae* (continued)

$$\frac{(20 \log_{10} 2000) \cdot \sqrt{1 + (20 \log_{10} 2000)^2}}{(20 \log_{10} 2000)^2 + (20 \log_{10} 2000)^2}$$

On the other hand the spectral mode functions  $\phi_n$  associated with the Dirichlet boundary conditions (2.1) are related to the unique  $L_2$  orthonormal expansion of modes  $\phi_n$  to  $\phi_n$  of the transfer matrix  $K$ . Following Chof. 4, this transfer matrix is conveniently expressed as  $K = QY$

$$(9) \quad \frac{1}{2} + \frac{1}{3} = \frac{3}{6} + \frac{2}{6} = \frac{5}{6}$$

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$$F(\mathbf{u}) = \frac{1}{2} \mathbf{u}^T \mathbf{A} \mathbf{u} + \frac{\gamma}{1-\gamma} \left( \sum_{i=1}^n \mathbf{u}_i^T \mathbf{A} \mathbf{u}_i - \mathbf{u}^T \mathbf{A} \mathbf{u} \right) + \frac{\gamma}{1-\gamma} \sum_{i=1}^n \mathbf{u}_i^T \mathbf{A} \mathbf{u}_i$$

where  $\eta_0$  is the vacuum impedance,  $\eta_0$  the linear metal conductivity,  $\epsilon$  the permittivity tensor of the dielectric, and  $\mathbf{E}$  an arbitrary transverse electric field. The boundary conditions at the interface of the metal and the dielectric are the continuity of the tangential component of the electric field and the normal component of the magnetic field. The normal component of the electric field is neglected because this surface is defined by the condition  $\mathbf{E} \cdot \mathbf{n} = 0$ , where  $\mathbf{n}$  is the normal to the surface. The tangential component of the electric field is neglected because this surface is defined by the condition  $\mathbf{E} \cdot \mathbf{n} = 0$ , where  $\mathbf{n}$  is the normal to the surface. The tangential component of the magnetic field is neglected because this surface is defined by the condition  $\mathbf{E} \cdot \mathbf{n} = 0$ , where  $\mathbf{n}$  is the normal to the surface.

At issue, too, is the fact that the Director of the Diplomatic Affairs is made up of two different people, the

$$m = \frac{g_1(T)g_2(T)}{g_1(T)g_2(T) + g_1(T)g_3(T) + g_1(T)g_4(T) + g_2(T)g_3(T) + g_2(T)g_4(T) + g_3(T)g_4(T)}$$

and consequently must be modified the group (19) to (19') with  $\gamma_{11}$  previously identified, in the form (see, e.g., Ref. 1):

[illegible]





### 3. ELECTROOPTICAL MODULATOR DESIGN

The structure depicted in Fig. 1 is the most suitable one to fabricate an electrooptical modulator that must realize a good coupling with the optical fibers and a high efficiency in can be employed in the communication systems of the near future. Furthermore, it needs to match the characteristic impedance of the whole distributed modulator with the microwave source. This can be easily accomplished by considering the equivalent line characteristic impedance corresponding to the two coupled strips when one is open terminated at both ends. Besides, the figure of merit of a such integrated optic device is related to the following integral [8]:

$$(9) \quad \eta_{A,E_1} = \frac{\sigma E_0}{2P} \int_{-\infty}^{\infty} E_0^* \cdot \Delta \epsilon(x, E_0) \cdot E_1 \, dx \, dy$$

that quantifies the coupling degree between an optical mode  $E_0$  guided in the metallic ion diffused core modeled by a permittivity tensor  $\epsilon(x)$  and an optical irradiated mode  $E_1$  that escapes into the substrate characterized by the bulk ordinary and extraordinary refractive indices  $n_{oe}$ ,  $n_{eo}$  at the optic wavelengths. The conversion [19] from  $E_0$  to  $E_1$  is induced by the application of the r.f. modulating electric field  $E_0$  that gives rise to a small deformation  $\Delta \epsilon(x, E_0)$  of the permittivity tensor because of the electrooptical effects in the ferroelectric crystals belonging to the symmetry point group 3m (LiNbO<sub>3</sub>, LiTaO<sub>3</sub>).  $P$  is the normalizing factor for the amplitudes of the waves  $E_0$  and  $E_1$  having the same propagation constant. The numerical optimization of the (9) together with impedance matching will be reported in a next job.

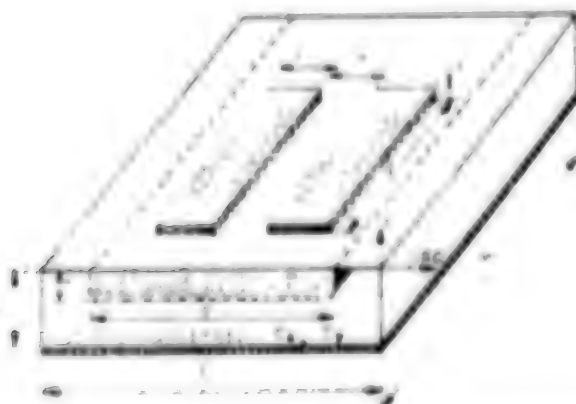


Fig. 1 Geometry of a traveling wave electrooptical modulator.



Fig. 2 Photograph of an experimental three-wander line fabricated on an "Al" alumina substrate.

### 4. MICROSTRIP PASSIVE NETWORK REALIZATION

As first step we have realized a single  $S_{11}$  microstrip line on alumina "Al" board 0.635 mm thick. The agreement between calculated and measured  $Z_0$  and  $r_{eff}$  was very excellent. Afterwards a three-wander line was fabricated as shown in Fig. 2. The strips connecting the wenders to the 50Ω connectors are 55.2  $\mu$ m because their width was chosen equal to 0.51 mm i.e. equal to the QSM ray width to avoid the discontinuity at the launchers. The loss factors for this device are:  $\alpha_{oe}/f=0.11$ ;  $\alpha_{od}/f=0.11$  in dB/(m GHz) and  $\alpha_{eo}/f=0.41$ ;  $\alpha_{oe}/f=0.94$ ;  $\alpha_{od}/f=1.39$  times  $10^{-3}$  dB/(mHz). The comparison between the evaluated lossless and dissipative results with the experimental data for the transfer  $S_{21}$  scattering parameter is presented in Fig. 3. By glancing at these curves we see that the losses unaffact the  $S_{21}$  phase whereas the highest deviation for the  $S_{21}$  is 37°. Moreover the agreement is comfortable both as regards to the realization facilities and measurement set available in our laboratory. In fact, the experimental error can be estimated, through the difference between measured  $S_{21}$  and  $S_{11}$ , as 17° for the moduli and 9° for the angles.





Fig. 9: Calculated (—) and measured (•) insertion loss of the filter of Fig. 6.

## 6. CONCLUSIONS

The complex  $2N$  port admittance matrix of a coupled microstrip or dielectric and/or isotropic substrate has been determined using the image method and with particular reference to the system images. As applications, we have explained the design criteria of a dielectric leaky wave modulator exhibiting electromechanical effects in anisotropic piezoelectric LiNbO<sub>3</sub> crystal. In this case the dielectric leaky factor is greater than the other one because of high  $\epsilon_r$  value at the microwave frequencies.

Furthermore, with the aid of the digital computer IBM 370/150, have been designed and, then, fabricated on alumina substrate a three window line and a hybrid gallium filter. The analysis data satisfactorily agree with the experiment results for both realized devices.

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CSO: 1500

## BRIEFS

TELECOMMUNICATION AGENCY'S LONG-RANGE PLAN--The Telecommunication Agency's long-range plans for expanding the capacity within the telephone network up to the 1990's is to a very great extent based on the use of PCM equipment. Pulse Code Modulation represents a technology which can increase the capacity within an existing cable network, and therefore is of great significance when the Telecommunications Agency plans its future network, when there will be rising numbers of subscribers and services. Standard Telefon og Kabelfabrik A/S since 1977 has worked closely with the Telecommunications Directorate in developing a new generation of PCM equipment and in applying modern technology. The equipment, which for the most part is being developed at the cable manufacturing firm's laboratory in Oslo according to demands and specifications established by the Telecommunications Directorate, is presently being delivered to the Telecommunications Agency for type approval. [Text] [Oslo NORGES HANDELS OG SJOPARTSTIDENDE in Norwegian 22 Dec 80 p 21]

CSO: 5500

SWEDEN

BRIEFS

TELECOMMUNICATIONS AGENCY REORGANIZATION--On Thursday near midnight the Riksdag approved the Government's proposal concerning a new organization for the Telecommunications Agency. The Agency is getting increased freedom in handling its economic affairs, and will have access to a flexible credit account of up to 800 million kronor. With this account the Agency will finance electron private branch exchanges, telex, telefax, and teletet exchanges. On several vital points the proposal was accepted by the vote of 160-159. [Text] [Stockholm SVENSKA DAGBLADET in Swedish 20 Dec 80 p 7]

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